



2-4-02 TL

1 --16.(as amended) A hand held pointing device for a computer system, the pointing device comprising:  
2 a housing having a bottom surface that moves against a desktop surface;  
3 the housing also having a top surface shaped to receive the human hand;  
4 the housing also having a skirt connecting a perimeter of the bottom surface with the  
5 top surface;

6 the housing also having a first axis extending generally in the direction from where the  
7 heel of the hand rests on the top surface to where the middle finger rests on the top surface, and  
8 a second axis perpendicular to the first, both axes parallel to the bottom surface;

9 an aperture in the bottom surface;

10 a source of non-coherent illumination mounted within the interior of the housing,  
11 proximate the aperture, that illuminates, from a single location and with an angle of incidence in  
12 the range of about five to twenty degrees, a portion of the desktop surface opposite the aperture  
13 and having surface height irregularities forming a micro texture with feature sizes in the range of  
14 about five to five hundred microns, the illumination producing highlights upon surface height  
15 irregularities that extend out of the desktop surface and that intercept the illumination and shadows  
16 upon surface height irregularities that extend into the desktop surface and whose illumination is  
17 blocked by adjacent surface height irregularities that are illuminated, the highlights and shadows  
18 forming a pattern that varies as a function of rotations and translations of the aperture relative to  
19 the desktop;

20 an optical motion detection circuit mounted within the interior of the housing and  
21 optically coupled to the highlights and shadows from the surface height irregularities of the  
22 illuminated portion of the desktop surface, the optical motion detection circuit producing motion  
23 signals indicative of motion in the directions along the first and second axes and relative to the  
24 surface height irregularities of the illuminated portion of the desktop surface; and

25 wherein the optical motion detection circuit comprises [a plurality]an array of photo  
26 detectors each having an output, a memory containing a reference frame of digitized photo  
27 detector output values that is stored in a reference array of memory locations corresponding to  
28 the array of photo detectors and a sample frame of digitized photo detector output values obtained  
29 subsequent to the reference frame and that is stored in a sample array of memory locations  
corresponding to the array of photo detectors, and further wherein a plurality of comparison

frames, each being a shifted version of one of the reference frame or the sample frame, is correlated with the other of the reference frame or the sample frame to ascertain motion in the directions along the first and second axes, the correlation being upon the values in all memory array locations that correspond to overlap between the comparison frame and the other of the reference frame or the sample frame.--;

--21.(as amended) A hand held pointing device for a computer system, the pointing device comprising:  
a housing having a bottom surface that moves against a work surface;  
the housing also having a top surface shaped to receive the human hand;  
the housing also having a skirt connecting a perimeter of the bottom surface with the top surface;  
the housing also having a first axis extending generally in the direction from where the heel of the hand rests on the top surface to where the middle finger rests on the top surface, and a second axis perpendicular to the first, both axes parallel to the bottom surface;  
an aperture in the bottom surface;  
a source of illumination mounted within the interior of the housing, proximate the aperture, that illuminates a portion of the work surface opposite the aperture and having surface height irregularities forming a micro texture with feature sizes in the range of about five to five hundred microns, the illumination producing a pattern of highlights upon surface height irregularities that extend out of the desktop surface and that intercept the illumination and of shadows upon surface height irregularities that extend into the desktop surface and whose illumination is blocked by adjacent surface height irregularities that are illuminated;  
an optical motion detection circuit mounted within the interior of the housing and optically coupled to the pattern of highlights and shadows from the surface height irregularities of the illuminated portion of the work surface, the optical motion detection circuit producing motion signals indicative of motion in the directions along the first and second axes and relative to the surface height irregularities of the illuminated portion of the work surface;  
wherein the optical motion detection circuit comprises [a plurality]an array of photo detectors each having an output, a memory containing a reference frame of digitized photo detector output values that is stored in a reference array of memory locations corresponding to

25 the array of photo detectors and a sample frame of digitized photo detector output values obtained  
subsequent to the reference frame and that is stored in a sample array of memory locations  
27 corresponding to the array of photo detectors, and further wherein a plurality of comparison  
frames, each being a shifted version of one of the reference frame or the sample frame, is  
29 correlated with the other of the reference frame or the sample frame to ascertain motion in the  
directions along the first and second axes, the correlation being upon the values in all memory  
31 array locations that correspond to overlap between the comparison frame and the other of the  
reference frame or the sample frame; and

33 a switch disposed on the skirt in a location underneath the right thumb or the left ring  
finger of a hand grasping the pointing device, that is coupled to the optical motion detection circuit  
35 and that inhibits the output of the motion signals to the computer system when the hand activates  
the switch by squeezing against the skirt in a plane parallel to the bottom surface in order to lift  
37 the pointing device away from the desktop surface.--; and

1 --22.(as amended) A hand held pointing device for a computer system, the pointing device comprising:  
a housing having a bottom surface that moves against a work surface;  
3 the housing also having a top surface shaped to receive the human hand;  
the housing also having a skirt connecting a perimeter of the bottom surface with the  
5 top surface;

the housing also having a first axis extending generally in the direction from where the  
7 heel of the hand rests on the top surface to where the middle finger rests on the top surface, and  
a second axis perpendicular to the first, both axes parallel to the bottom surface;

9 an aperture in the bottom surface;

a source of illumination mounted within the interior of the housing, proximate the  
11 aperture, that illuminates a portion of the work surface opposite the aperture and having surface  
height irregularities forming a micro texture with feature sizes in the range of about five to five  
13 hundred microns, the illumination producing a pattern of highlights upon surface height  
irregularities that extend out of the desktop surface and that intercept the illumination and of  
15 shadows upon surface height irregularities that extend into the desktop surface and whose  
illumination is blocked by adjacent surface height irregularities that are illuminated;

17 an optical motion detection circuit mounted within the interior of the housing and  
18 optically coupled to the pattern of highlights and shadows from the surface height irregularities  
19 of the illuminated portion of the work surface, the optical motion detection circuit producing  
20 motion signals indicative of motion in the directions along the first and second axes and relative  
21 to the surface height irregularities of the illuminated portion of the work surface;

22 wherein the optical motion detection circuit comprises [a plurality]an array of photo  
23 detectors each having an output, a memory containing a reference frame of digitized photo  
24 detector output values that is stored in a reference array of memory locations corresponding to  
25 the array of photo detectors and a sample frame of digitized photo detector output values obtained  
26 subsequent to the reference frame and that is stored in a sample array of memory locations  
27 corresponding to the array of photo detectors, and further wherein a plurality of comparison  
28 frames, each being a shifted version of one of the reference frame or the sample frame, is  
29 correlated with the other of the reference frame or the sample frame to ascertain motion in the  
30 directions along the first and second axes, the correlation being upon the values in all memory  
31 array locations that correspond to overlap between the comparison frame and the other of the  
32 reference frame or the sample frame; and

33 a switch disposed on the skirt in a location underneath the left thumb or the right ring  
34 finger of a hand grasping the pointing device, that is coupled to the optical motion detection circuit  
35 and that inhibits the output of the motion signals to the computer system when the hand activates  
36 the switch by squeezing against the skirt in a plane parallel to the bottom surface in order to lift  
37 the pointing device away from the desktop surface.--

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